UNIT I

Number Systems & Boolean Algebra

Binary arithmetic

BINARY ARITHMETIC

- The computer is a digital system that supports various arithmetic operations. It performs addition subtraction , multiplication and division over the binary dat.
- To learn the basic circuits of a digital system , it is necessary to study binary arithmetic operation such as binary addition , binary subtraction , binary multiplication and binary division .

1. Binary Addition

0+0=0, 0+1=1, 1+0=1, and 1+1=10

example: 10110111
+ 01110101
Carry 1110111

100101100

2. Binary Subtraction

- The subtraction of two binary numbers is performed exactly in the same manner as the subtraction of decimal numbers.
- 0-0=0, 0-1= -1, 1-0=1 and 1-1=0
- 0-1= -1 the result is negative it indicates that the second number is greater than the first one. Similar to decimal number system , a borrow is generated.

Example:

```
    10100111
-   01110101
    111          Borrow
  ----------
    00110010
```

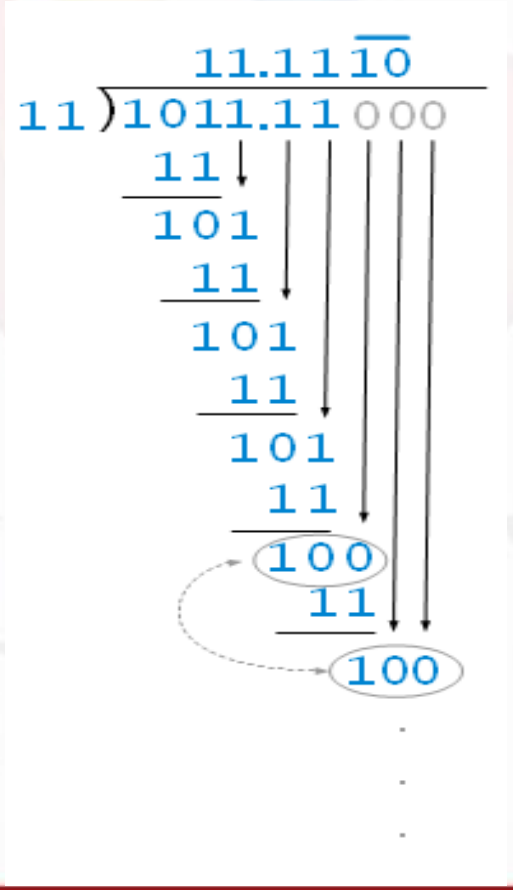
3. Binary Multiplication

- Its similar to the decimal multiplication . If the multiplier bits is 1, then the partial product is same as the multiplicand. If the multiplier bit is 0, then the partial product is 0.
- Example : 1010* 1001

```
     1010   multiplicand
     1001   multiplier
----------------
     1010
    0000-
   0000--
  1010---
----------------
1011010
```

4. Binary Division

The binary division is same as the decimal division . Binary division has two results. i.e. quotient and remainder. Let us consider the example : 1011.11 is divided by 11



Basic Terminology

Gate : A device that performs a basic operation on electrical signals.

Boolean expressions: Uses Boolean algebra, a mathematical notation for expressing two-valued logic

Logic diagrams: A graphical representation of a circuit; each gate has its own symbol

Truth tables: A table showing all possible input value and the associated output values.

Six types of gates : NOT, AND, OR, XOR, NAND, NOR

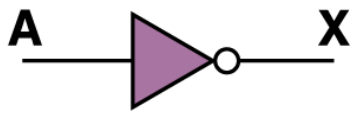
NOT Gate

A NOT gate accepts one input signal (0 or 1) and returns the opposite signal as output.

Boolean Expression

$X = A'$

Logic Diagram Symbol



Truth Table

A	X
0	1
1	0

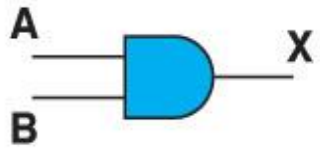
AND Gate

An AND gate accepts two input signals. If both are 1, the output is 1; otherwise, the output is 0

Boolean Expression

$X = A \cdot B$

Logic Diagram Symbol



Truth Table

A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

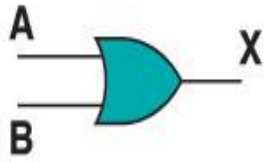
OR Gate

An OR gate accepts two input signals. If both are 0, the output is 0; otherwise, the output is 1

Boolean Expression

$X = A + B$

Logic Diagram Symbol



Truth Table

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

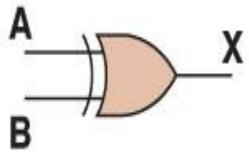
XOR Gate

An XOR gate accepts two input signals. If both are the same, the output is 0; otherwise, the output is 1

Boolean Expression

$X = A \oplus B$

Logic Diagram Symbol



Truth Table

A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

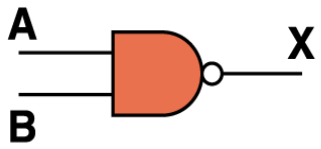
NAND Gate

The NAND gate accepts two input signals. If both are 1, the output is 0; otherwise, the output is 1

Boolean Expression

$X = (A \cdot B)'$

Logic Diagram Symbol



Truth Table

A	B	X
0	0	1
0	1	1
1	0	1
1	1	0

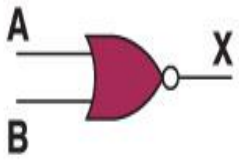
NOR Gate

The NOR gate accepts two input signals. If both are 0, the output is 1; otherwise, the output is 0

Boolean Expression

$X = (A + B)'$

Logic Diagram Symbol



Truth Table

A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

Thank You